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IX.—*Survey made for a Canal, through the River Sapoa, to the Port of Salinas or Bolaños, in Costa Rica.* By MAGISTER ANDREAS OERSTED, of Copenhagen. Presented by Mr. G. FYLER.

[Read June 9, 1851.]

DR. FRANCISCO OREAMUNO having mentioned to me a spot in the department of Guanacaste, which he thought would be the most favourable for cutting a canal to unite the Lake of Nicaragua with the Pacific, I—having to make a journey to that department for the purpose of continuing my researches in natural history, and knowing that the Government of this State takes a great interest in every project likely to prove advantageous to the country—desired to make, in company with Dr. F. Gutterriz, all the investigations of which the short space of time and the want of necessary instruments would admit. Thus it is that I take the liberty of presenting to your Excellency this short account, together with the topographical sketch-map of that department.

The formation of a canal in that part is quite possible; on one side a long passage in the bed of the river Sapoa, and on the other the beautiful low level country which extends from the Pacific along the salt lagoons of Bolaños into that river, present undoubted facilities. The following is the description of these places:—

The river Sapoa, from its entrance in the Lake of Nicaragua, to the Creek of Sonsapor.

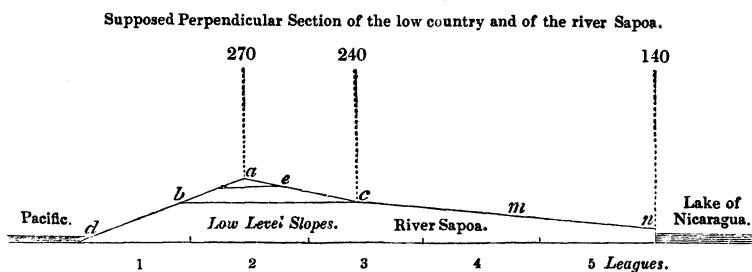
The Sapoa is one of the largest rivers discharging its waters into the Lake of Nicaragua. At its mouth it has a width of 200 yards, with a depth of 2 to 3, and it is never choked up with sand-banks. At a quarter of a league's distance from its mouth it has a depth of 10 yards, diminishing gradually; and it is navigable for the largest canoes up to within three-quarters of a league from its mouth. Higher up, although navigable, there are rapids. We embarked at a quarter of a league from the mouth, and proceeded up to the creek of Cabalcota, where there is a small rapid close to Peña blanca (White rock). This rapid is formed by two arms into which the river is there divided. One of these, with a little cost, might be made navigable for all sorts of canoes. Near Cabalcota the width of the river is 25 yards, gradually diminishing in depth up to the mouth of the Sonsapor. In this latter part, from Cabalcota to Sonsapor, which is about $1\frac{3}{4}$ leagues distance, the navigation is rendered very difficult, if not impossible, by numerous rocks and rapids. The course of the river from its mouth to this place is N. and S.

Description of the low level country between the Pacific and the river Sapoa.

This low level is nothing more than a continuation of the low coast formed by the salt lagoons of Bolaños towards the N.E. ; this coast rises very slowly for 6600 yards from the sea, where you reach the highest point, which point does not appear to be higher than 270 feet. This inconsiderable height has a length of 1200 yards, whence it slowly descends towards the river Sapoa, forming thus the separation between the waters which run into the Pacific and those which flow to the Sapoa. The waters to the Pacific flow only in the rainy season, and those to the Sapoa are formed by two creeks, the Nispiro and Sonsapor, which unite and flow into the Sapoa.

This low country has on both sides high ridges of land, but does not present any sudden rises nor any other impediment except a few large stones. Measuring exactly the distance from the sea to the road, which goes from the mouth of the Sapoa near that river and passes by the declivity "Del Obispo," there is a distance of 12,600 yards ; so that the total extent of the low country does not much exceed 2 Spanish leagues.

Respecting the cutting a Canal in these places.



The communication of the Lake of Nicaragua with the Pacific at the points thus projected consists in cutting a canal of $2\frac{1}{4}$ leagues along the course of the river Sapoa, and a canal through the low level or sloping country, which is $2\frac{1}{4}$ leagues in extent. The river Sapoa for a distance of 1 league is already navigable, the remaining league and three-quarters offer no difficulty to cutting a canal, as a small excavation of the same river and a few locks will be sufficient. In order to cut a canal through the sloping country, it will be necessary to bring it to the same level as the river Sapoa at the mouth of the creek of Sonsapor, a distance of 6700 yards, to the eastern side of the elevation *c b*. For this

purpose it would be necessary to make a small excavation of 5000 yards in length from *c* to *e*, and another deeper one of 1200 yards from *e* to *b*. The other side of the low level (slope), as far as the Pacific, may be cut through by a small excavation and a few locks.

From the foregoing it is presumed that the plan of conducting the waters of the lagoon or lake into the Pacific would not be entertained at all, as this, owing to the nature of the soil, would be very difficult, if not impossible. Nor would it be at all required, as the river Sapoa contains quite water enough for the canal on one side in one direction, and the creeks of Nispiro and Sonsapor, added to the waters which irrigate the descent to the Pacific, would furnish quite sufficient in the other. It may be well to notice here that all this country has a firm soil, composed of porphyry, with the exception of that part of the descent next to the Pacific, which consists of sandy clayey soil. The porphyry has the advantage for the excavation, that in many parts it is composed of mounds, which break very easily.

Thus it appears that the whole canal would consist of—

River Sapoa :—

- 1 league of the river Sapoa, navigable (*n, m*).
- 1½ leagues of same river, with a small excavation (*m, c*).

Low, level, sloping Country :—

- 7,500 yards of small excavation (*c, e*).
- 1,200 do. of rather deeper do. (*e, b*).
- 6,000 do. of small do. (*c, d*).

OBSERVATIONS.

*Comparison between this spot and that examined and proposed by
Mr. Bayley, for making a Canal.*

The value of things is relative. In order to learn the value of this point it is necessary to compare it with other points already projected and explored. If there exists a better spot, the value of this one, notwithstanding the various advantages it may possess, is less than the other; but if there be no other point as good, then the one here advocated should be preferred. It is for this reason that cutting a canal in this spot appeared to me difficult before I knew the observations which Mr. Bayley had made at another point; but since I have seen them, and compared the two, it appears to me that the one here projected offers many more facilities.

The spot proposed by Mr. Bayley extends from the mouth of the river San Juan del Sud, on the Pacific, in a direct line as far as the Lake of Nicaragua, making a distance of a little more than

5 leagues. At this point there is a ridge of high mountains, which would require a tunnel of $\frac{1}{3}$ of a league, and a very deep excavation of more than $\frac{2}{3}$ of a league, and for the remainder a small excavation. Thus, while it appears that there is hardly any difference in the extent of both canals, the plan here proposed by me possesses two advantages, viz.:—1st. *That one league is already navigable naturally*; 2nd. *That no tunnel will be necessary*.

Last Observation.

It should be borne in mind that all the levels in a perpendicular, as well as a horizontal direction (with the exception of the level of the sloping ground), have been taken approximately, so that on this account no very exact calculation can be made of the expense that would be incurred in making a canal. I think, however, that this survey is sufficient to prove that a canal can be made here with more ease and with less expense than in any other place as yet explored. The object of this statement can be no other than to encourage the supreme Government to have the ground examined by parties who may possess sufficient knowledge for making a minute investigation and an exact calculation, and thus give an impulse towards realizing an idea which, more than any other, is calculated to promote the welfare and grandeur of this country. The great value which the realization of it would have for the commerce of the whole world is so clear, that the carrying into effect such an undertaking has been for many years a great desideratum of all nations. These are the slight observations which I have been enabled to make in the short time during which I remained in the department of Guanacaste. The narrative which I give of them is perhaps not so exact as it should be, owing to the difficulty I feel in expressing my ideas in a foreign tongue. Nevertheless, if the President should consider them worthy of his attention and of some utility to the country, it will be a reward sufficient for me and I shall be satisfied; requesting only that the defects which my account contains may be excused.

X.—*Observations on the Geography of Southern Peru, including Survey of the Province of Tarapaca, and Route to Chile by the coast of the Desert of Atacama.* By W. BOLLAERT, F.R.G.S

[Read April 28, 1851.]

A RESIDENCE of some years in Lower Peru, in the province of Tarapaca, department of Arequipa, commencing in 1826, during which I was engaged in mining operations at the celebrated silver-